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## PATENT SPECIFICATION

DRAWINGS ATTACHED

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### COMPLETE SPECIFICATION

#### Improvements relating to Pumps

We, DAVID HORACE YOUNG and HENRY JOHN TRETHEWY, both British subjects, of 54, St. James's Avenue, Hampton Hill, Middlesex, and 36 York Road, Aldershot, Hampshire, respectively, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pumps and rams, more particularly (but not exclusively) of the kind where one fluid pressure is used to produce another fluid pressure which is substantially greater.

The invention makes use of rolling diaphragms: such diaphragms are sealed to a cylinder wall and moved therein by an undersize piston the diaphragms being accommodated in part between the cylinder wall and the piston. Various types of rolling diaphragm are available in commerce and sold under the registered trade mark "BELLOFRAM" by George Angus and Co. Ltd. of Wallsend-on-Tyne. One advantage of rolling diaphragms is that they enable manufacture of piston and cylinder to easier tolerances. Another is that they provide a complete seal against passage of fluid around the piston.

It is however important that rolling diaphragms should always be subjected to a resultant fluid pressure directed on to the crown of the piston. If this pressure is not maintained continuously but instead changes in direction then the diaphragm may "reverse" with consequent rapid wear and failure. The danger of "reversal" has hitherto limited the use of rolling diaphragms, and the object of the present invention is to provide a pump free from this danger.

Accordingly the invention provides a pump having a body providing a pair of cylinders aligned on a common axis, a pair of opposed pistons movable in the cylinders and sealed thereto by oppositely arranged rolling diaphragms, one of the pistons being capable of

actuation to cause movement of the other piston; the cylinder containing the other piston forming, on the side opposite said one piston, a pump chamber associated with inlet and exhaust means, means resiliently urging said other piston towards said one piston and a fluid (preferably liquid) filling the space between the pistons and transmitting forces between them, the arrangement being such that at each moment of the working cycle the fluid is subjected to pressure and in turn produces a pressure on the diaphragms which is unchanging in direction throughout the cycle.

One embodiment of the invention will now be described by way of example with reference to the diagrammatic drawing accompanying the provisional specification which drawing shows a section of a pump.

The pump illustrated comprises first second and third cylinders aligned on a common axis and indicated at 1, 2, 3, each cylinder having a piston therein designated respectively 4, 5, 6; the first and third cylinders are of equal diameter, and the second is of smaller diameter. The first and second pistons 4, 5, are rigidly interconnected and sealed to the respective cylinders by rolling diaphragms 7, 8, the diaphragm 7 having its periphery clamped between two wall sections 9, 10, of the cylinder 1 and the diaphragm 8 having its periphery clamped between a wall 11 of the cylinder 2 which is secured to one end of the wall section 10 and an annular plate 12 secured to the wall 11 at the other end. The third piston 6 is sealed to the third cylinder 3 by a third rolling diaphragm 13 having its periphery clamped between the plate 12 and a wall section 14 of the third cylinder. A powerful helical compression spring 16 is mounted in the fluid cylinder 3 to urge the piston 6 therein upwards. The space between the diaphragms 8 and 13 is filled with liquid 15, and the space between the diaphragms 7, 8, is filled with air, and vented to atmosphere by the port 20.

In operation of the pump, operating fluid

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1 SHEET

PROVISIONAL SPECIFICATION

*This drawing is a reproduction of  
the Original on a reduced scale*

